

Claims

What is Claimed is:

5 1. A method of manufacturing an optical waveguide preform, said method comprising:

exposing a soot preform to an atmosphere including a chlorine-containing compound and thereby doping the soot preform with chlorine, wherein the absolute pressure of the atmosphere is greater than about 1.013×10^2 kPa.

10 2. The method of Claim 1 including, prior to said step of exposing the soot preform, inserting the soot preform into a consolidation furnace.

15 3. The method of Claim 1 including:
drying the soot preform prior to said step of exposing the soot preform;
and
sintering the soot preform following said step of exposing the soot preform.

20 4. The method of Claim 1 wherein the mole percentage of chlorine present in the atmosphere is greater than about 20%.

25 5. The method of Claim 1 wherein the mole percentage of chlorine present in the atmosphere is between about 20% and 40%.

6. The method of Claim 1 wherein the weight percentage of chlorine present in the soot preform is greater than about 1%.

30 7. The method of Claim 1 wherein the weight percentage of chlorine present in the soot preform is between about 1.0% and 1.5 %.

8. The method of Claim 1 wherein the chlorine-containing compound is selected from the group consisting of GeCl_4 , SiCl_4 , Cl_2 , CCl_4 , SOCl_2 , POCl_3 and combinations thereof.

5 9. The method of Claim 1 wherein the atmosphere is at a temperature of at least about 1000 °C.

10 10. The method of Claim 1 wherein the atmosphere is at a temperature of between about 1250 and 1350 °C.

10 11. The method of Claim 1 wherein the absolute pressure of the atmosphere is greater than about 2.026×10^2 kPa.

15 12. The method of Claim 1 wherein the absolute pressure of the atmosphere is between about 4.052×10^2 and 16.32×10^2 kPa.

13. The method of Claim 1 including exposing the soot preform to the atmosphere for a period of at least 60 minutes.

20 14. The method of Claim 1 including exposing the soot preform to the atmosphere for a period of between about 60 and 180 minutes.

25 15. The method of Claim 1 wherein the soot preform includes silica and a material selected from the group consisting of germanium, fluorine, boron, phosphorous, erbium, antimony, aluminum, and titanium.

30 16. The method of Claim 1 including forming the optical waveguide preform such that the optical waveguide preform includes an inner layer formed from the chlorine doped soot preform and an outer layer surrounding the inner layer, wherein:

the soot preform and the outer layer are formed of materials having different viscosities at drawing temperatures in the range of between about 1600 and 2150 °C; and

the chlorine doping of the soot preform improves matching of the viscosities of the inner layer and the outer layer at said drawing temperatures as compared to a non-chlorine doped inner layer.

5 17. The method of Claim 16 wherein the inner layer includes silica and a material selected from the group consisting of germanium, fluorine, boron, phosphorous, erbium, antimony, aluminum and titanium.

10 18. The method of Claim 17 wherein the outer layer includes silica and a material selected from the group consisting of boron, phosphorous and fluorine.

15 19. A method of manufacturing an optical waveguide preform, said method comprising:

 exposing a soot preform to an atmosphere including a chlorine-containing compound for a period of at least 60 minutes and thereby doping the soot preform with chlorine, wherein:

 the absolute pressure of the atmosphere is greater than about 1.013×10^2 kPa;

 the mole percentage of chlorine present in the atmosphere is greater than about 20%;

 the weight percentage of chlorine present in the soot preform is greater than about 1%;

 the chlorine-containing compound is selected from the group consisting of GeCl_4 , SiCl_4 , Cl_2 , CCl_4 , SOCl_2 , POCl_3 and combinations thereof; and

 the atmosphere is at a temperature of at least about 1000 °C.

20 20. The method of Claim 19 including, prior to said step of exposing the soot preform, inserting the soot preform into a consolidation furnace.

25 21. The method of Claim 19 including:
 drying the soot preform prior to said step of exposing the soot preform;
 and

sintering the soot preform following said step of exposing the soot preform.

22. The method of Claim 19 wherein the mole percentage of chlorine present in the atmosphere is between about 20% and 40%.

23. The method of Claim 19 wherein the weight percentage of chlorine present in the soot preform is between about 1.0% and 1.5 %.

24. The method of Claim 19 wherein the atmosphere is at a temperature of between about 1250°C and 1350 °C.

25. The method of Claim 19 wherein the absolute pressure of the atmosphere is greater than about 2.6×10^2 kPa.

26. The method of Claim 19 wherein the absolute pressure of the atmosphere is between about 4.052×10^2 and 16.32×10^2 kPa.

27. The method of Claim 19 including exposing the soot preform to the atmosphere for a period of between about 60 and 180 minutes.

28. The method of Claim 19 wherein the soot preform includes silica and a material selected from the group consisting of germanium, fluorine, boron, phosphorous, erbium, antimony, aluminum, and titanium.

29. The method of Claim 19 including forming the optical waveguide preform such that the optical waveguide preform includes an inner layer formed from the chlorine doped soot preform and an outer layer surrounding the inner layer, wherein:

the soot preform and the outer layer are formed of materials having different viscosities at drawing temperatures in the range of between about 1600 and 2150 °C; and

the chlorine doping of the soot preform improves matching of the viscosities of the inner layer and the outer layer at said drawing temperatures as compared to a non-chlorine doped inner layer.

5 30. The method of Claim 29 wherein the inner layer includes silica and a material selected from the group consisting of germanium, fluorine, boron, phosphorous, erbium, antimony, aluminum, and titanium.

10 31. The method of Claim 30 wherein the outer layer includes silica and a material selected from the group consisting of boron, phosphorous and fluorine.

15 32. An apparatus for manufacturing an optical waveguide preform using a soot preform, said apparatus comprising:

 a) a furnace defining a chamber adapted to contain the soot preform and including a heating device operable to heat said chamber; and

 b) a fluid control system operable to provide an atmosphere including a chlorine-containing compound in said chamber at an absolute pressure of greater than about 1.013×10^2 kPa.

20 33. The apparatus of Claim 32 wherein said fluid control system includes: a flow control device selectively operable to prevent and allow flow of said atmosphere into and out of said chamber;

 a pressurizing device operable to pressurize said atmosphere in said chamber to a selected pressure; and

25 a controller operative to control said flow control device and said pressurizing device.

30 34. The apparatus of Claim 33 wherein said flow control device includes at least one valve.

 35. The apparatus of Claim 33 wherein said pressurizing device includes a compressor.